APPENDIX FOR FISHING FOR A LIVING:
HOW DO WE KNOW WHAT ALBATROSSES EAT?

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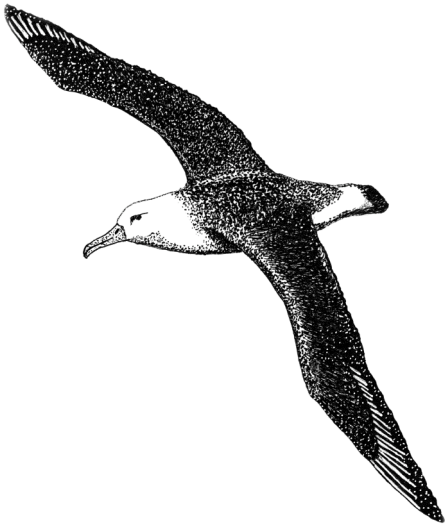
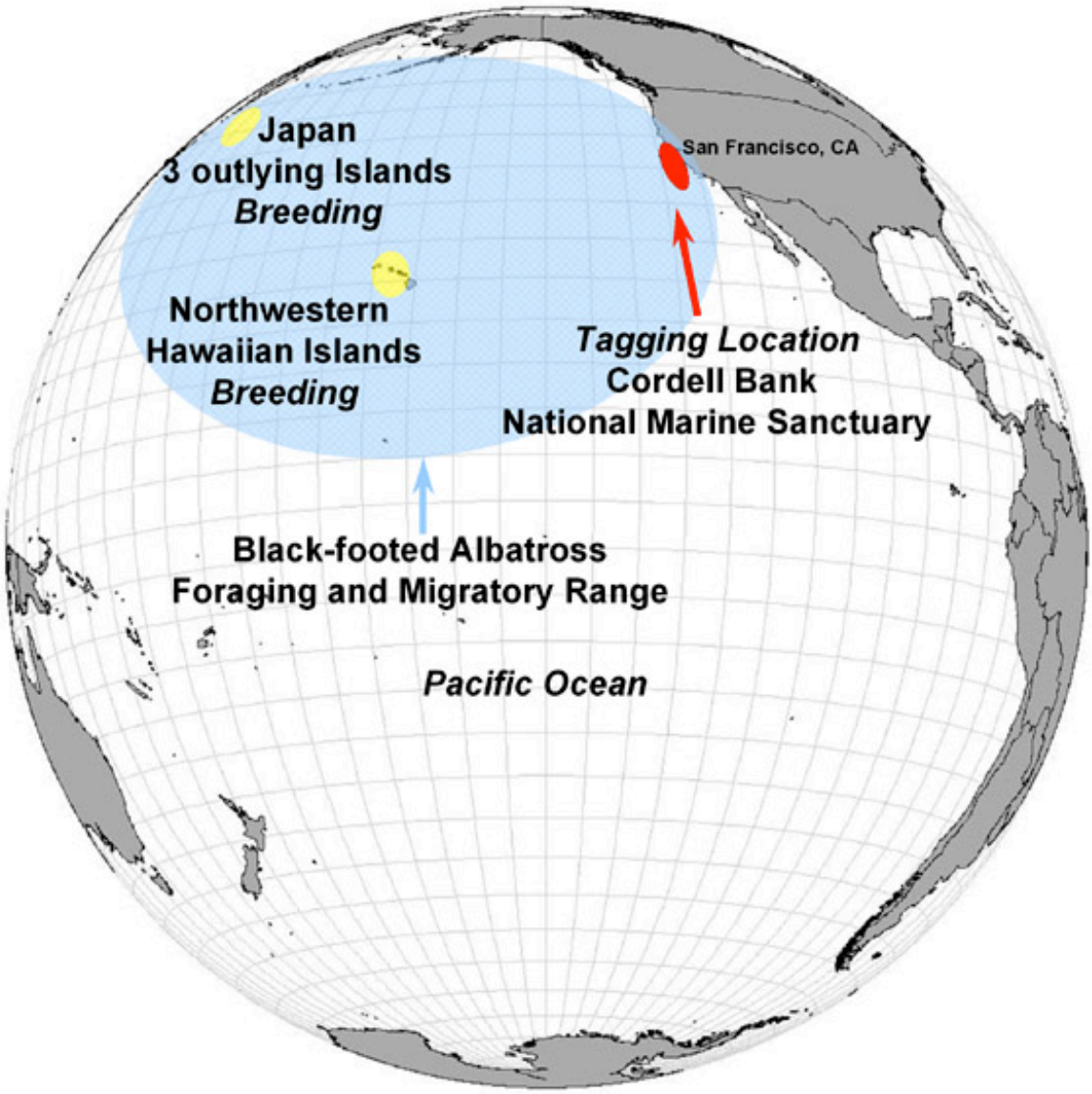
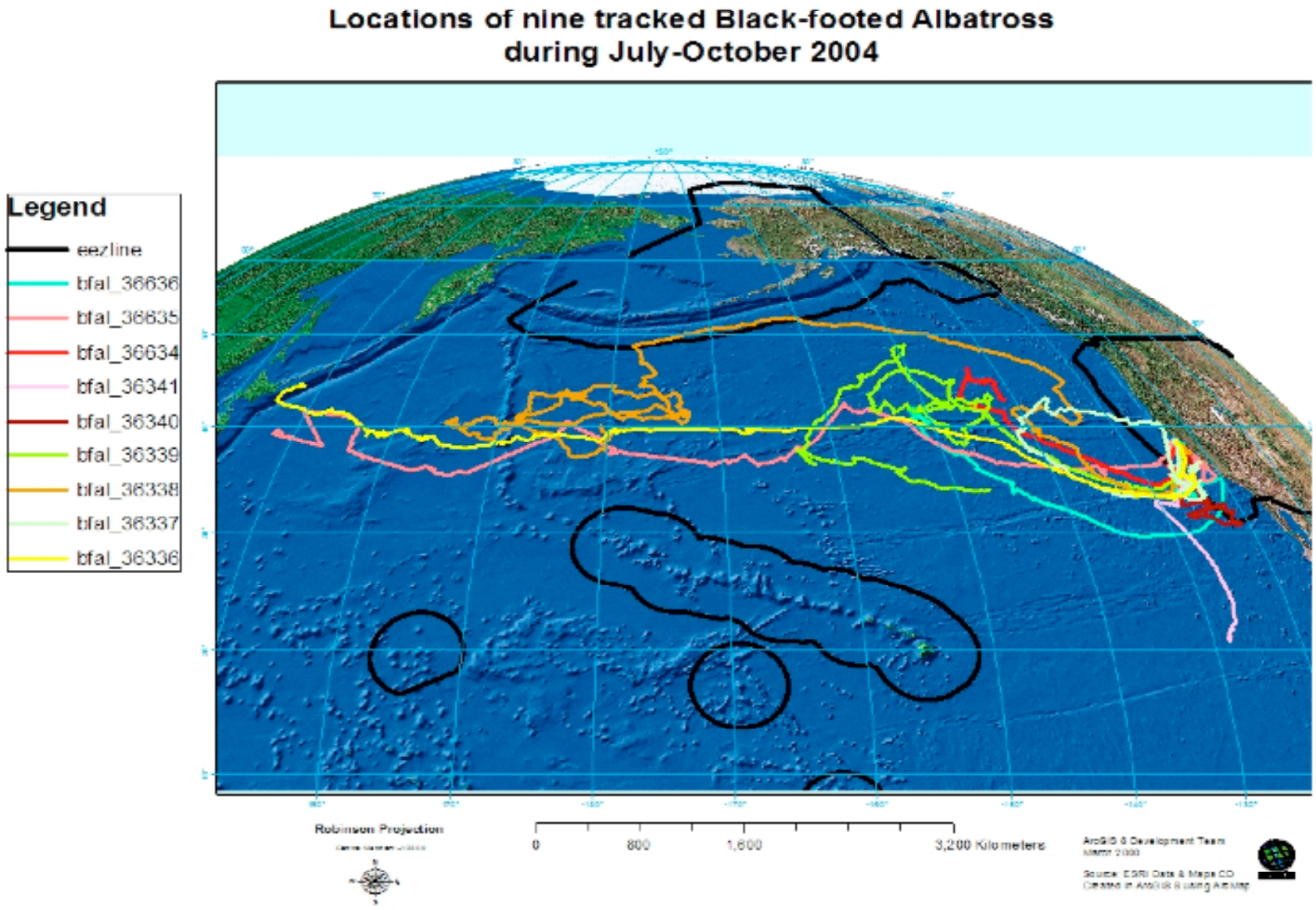


Map #1: Black-footed Albatross Foraging and Migratory Range

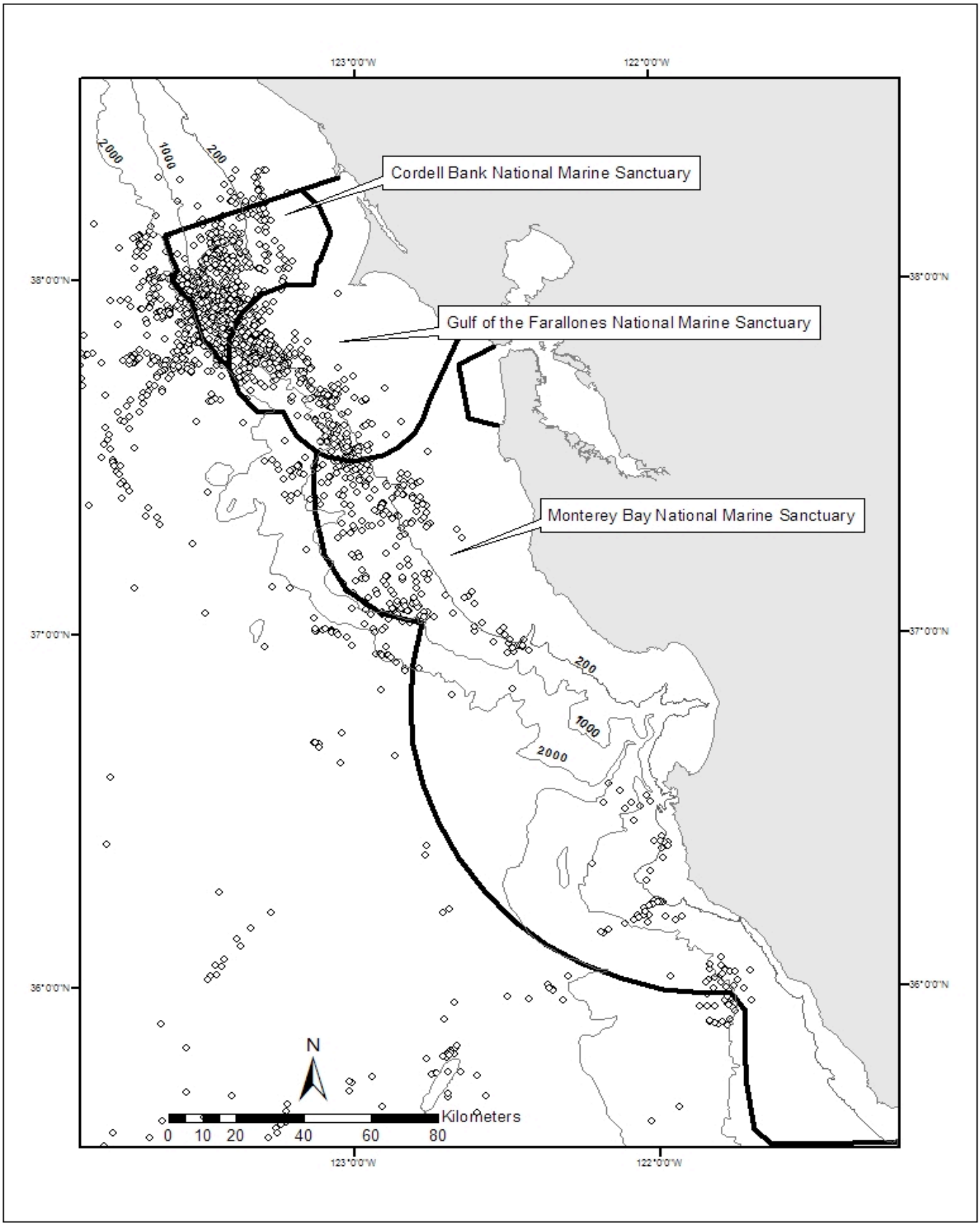


Source: Hester, M. Oikonos Ecosystem Knowledge 2005

Map #2: Movements of 9 albatrosses tagged in the summer of 2004



Map #3 Use of National Marine Sanctuaries by 9 albatrosses tagged in the summer of 2004



Lab Investigation 1: Bolus Investigations

Introduction:
Albatrosses feed their chicks by regurgitating lots of squid, flying fish eggs, and fish larva into their chicks mouth. A bolus is all the indigestible material that is "thrown up" by a juvenile chick. Its shaped like a fat cigar when it comes out. Dissecting these boluses can give us an idea of what the albatrosses are eating, both natural and unnatural items can be identified. In this packet we have provided 3 photos of boluses (already dissected and laid out) to analyze.

In this lab exercise we will be dissecting a bolus and identify and count the contents.

NOTE: depending on availability of boluses, we will dissect it as a class project, or divide into groups. Options if boluses are not available: 1) use color photos of bolus dissections and identify and count contents. If you are so lucky to have a bolus, consider mounting it to a board for permanent display with your students. 2) make "boluses" using photos as a guide

1) Visually inspect bolus sample by gently pulling apart (or use color photos of boluses) and use Data Sheet to record its contents. Have students write overall impressions in Comments and Notes section.

2) Have students answer the following:

- maximum size of items?
- minimum size of items?
- transparent / translucent items?
- color: bright (yellow / red) or dull (blue / green)?
- can you identify recognizable plastic items? what are they?
- industrial plastic (pellets) or consumer plastic (broken)?
- evidence of fisheries? Monofilament / light-sticks / hooks?
- any rocks seeds?

Albatrosses may ingest rocks (pumice) and seeds that float in the ocean as fish eggs attach to these floating items.

3) Have students answer questions on Student Answer sheet. (Appendix page 15)

Albatross Bolus Investigation Data Sheet

Names of Investigators:

TOTAL NUMBER ITEMS IN BOLUS:

NATURAL PREY ITEMS	Count	Percent of Total (Count/Total)*100

NON-NATURAL ITEMS		
RECOGNIZABLE PLASTIC (e.g.bottle caps)	Count	Percent of Total (Count/Total)*100

PLASTIC FRAGMENTS (list color & shape)	Count	Percent of Total (Count/Total)*100

OTHER NON-NATURAL ITEMS	Count	Percent of Total (Count/Total)*100

TOTALS	Count	Percent of Total (Count/Total)*100
Natural items		
Non-natural items		

Comments & Notes

Lab Activity 2 Plastic Investigations

Introduction: BACKGROUND ON PLASTIC

One of the major threats to marine life is the pollution by plastic debris. Almost every seabird on the planet has plastic waste inside it; the scale and extent of plastic pollution is staggering. The increase in plastic production and corresponding rise in the amount of plastic debris circulating and accumulating in the oceans has resulted in an increase in the amount of plastics ingested by seabirds. Some seabirds select specific plastic shapes and colors, mistaking them for potential prey items. Albatross also ingest cigarette lighters, lightsticks, and monofilament nylon line.

Albatrosses do not dive for their food; they pick food off the surface of the water. Seabirds misidentify plastic and other marine debris as prey; albatrosses eat flying fish eggs and if eggs are attached to a floating non-food item such as pumice, they will eat the eggs along with the pumice; they will also eat both pelagic barnacles and the non-food item to which they are attached. Some important things to think about *are*
1) birds' beaks determine the size of the food they eat
2) color is important e.g. blue and white would be harder to see than red plastic objects. (Results from a study on Albatrosses in New Zealand indicated Shy albatrosses are eating red coke bottle tops)
3) Albatrosses do not go after blue-dyed bait which is a common mitigation technique for bycatch
4) black-footed albatross and Laysan albatross eat plastic wrappers.

Other questions to think about: Would black-footed albatross/Laysan albatross eat M&M wrappers or plastic that is transparent? Do large pieces of plastic break up into smaller pieces? Why are there so many bottle caps? Where do they come from? Do people throw them away or do the lighter bottles disintegrate and leave the caps intact?

In this lab exercise we will sort and determine if debris is detrimental to albatrosses or not. Introduce the Dichotomous key as a tool for classifying things. Typically, its used to identify organisms. Create and use a Dichotomous Key to determine if an albatross would eat an item using samples of plastic collected. Use what you have learned about birds' beaks and feeding strategies to think about creating a key that will identify which pieces of debris are most detrimental to albatrosses.

Procedure: Introduce students to plastics in seabirds using the "Seabirds and Plastic" CD presentation provided in this activity packet. (*note this powerpoint is written at a high level, take what is appropriate to your age group)

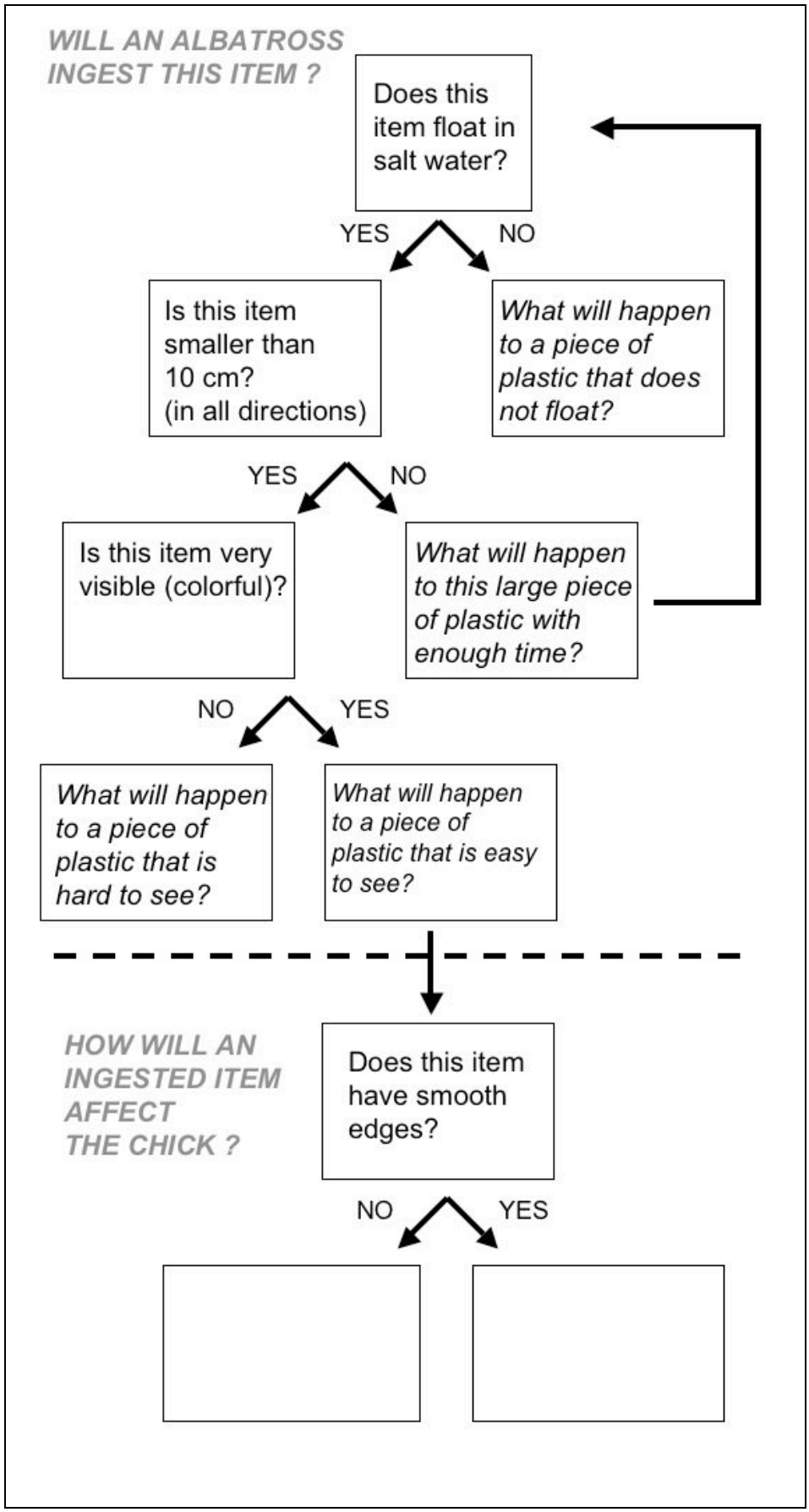
1) Have students collect trash, specifically plastic, for this activity (at a beach, around their neighborhoods, homes, and schools
2) Assemble all plastic in a pile and examine closely
3) Would these objects sink or float in fresh water or sea water?
4) Write down some characteristics about your plastic pile
- maximum sizes
- minimum sizes
- transparent / translucent
- color: light, medium, or dark colors
- color: bright (yellow / red) or dull (blue / green)
- industrial plastic (pellets) or consumer plastic (broken)
- rounded or sharp edges
- evidence of fisheries? Monofilament / light-sticks / hooks
- any rocks? seeds?

5) Group together objects that have similar values (colorful/transparent, similar size) and create subgroups
6) Start with most general characteristics and progress to increasingly more specific characteristics
NOTE: see the following for reference on dichotomous keys
http://www.park.edu/bhoffman/courses/bi225/labs/Dichotomous%20Keys%202.htm

Items needed for activities: (**Bold** font indicates items commonly eaten by albatrosses)
- bottle caps: **plastic** (float) vs metal (sink)
- **red bottle caps** (small) vs (tennis can tops (large)
- **red** / white plastic bottle caps: visibility
- plastic wrap (transparent) vs **paper wrapper** (colorful)
- **small styrofoam** vs large styrofoam (size)

tricky questions: do albatrosses eat these items?
- hooks? they do not float: yes if attached to a line
- pumice? floats or taken from colonies or water near colonies
- need to show small pieces of broken plastic from a large piece (so it's not ok to throw away large items they break down and birds will eat them)

Dichotomous key example

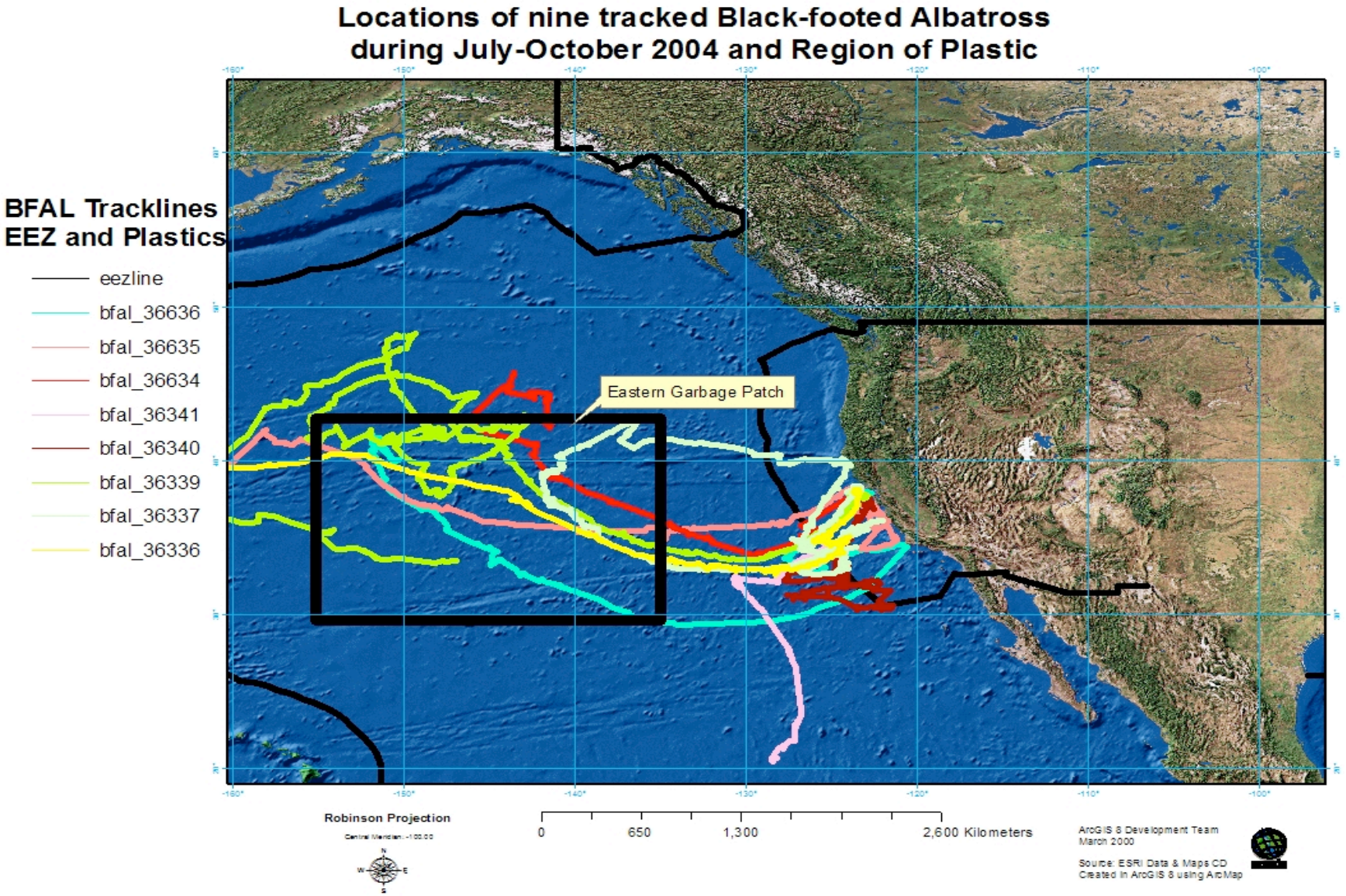


PLASTIC DICHOTOMOUS KEY WORKSHEET

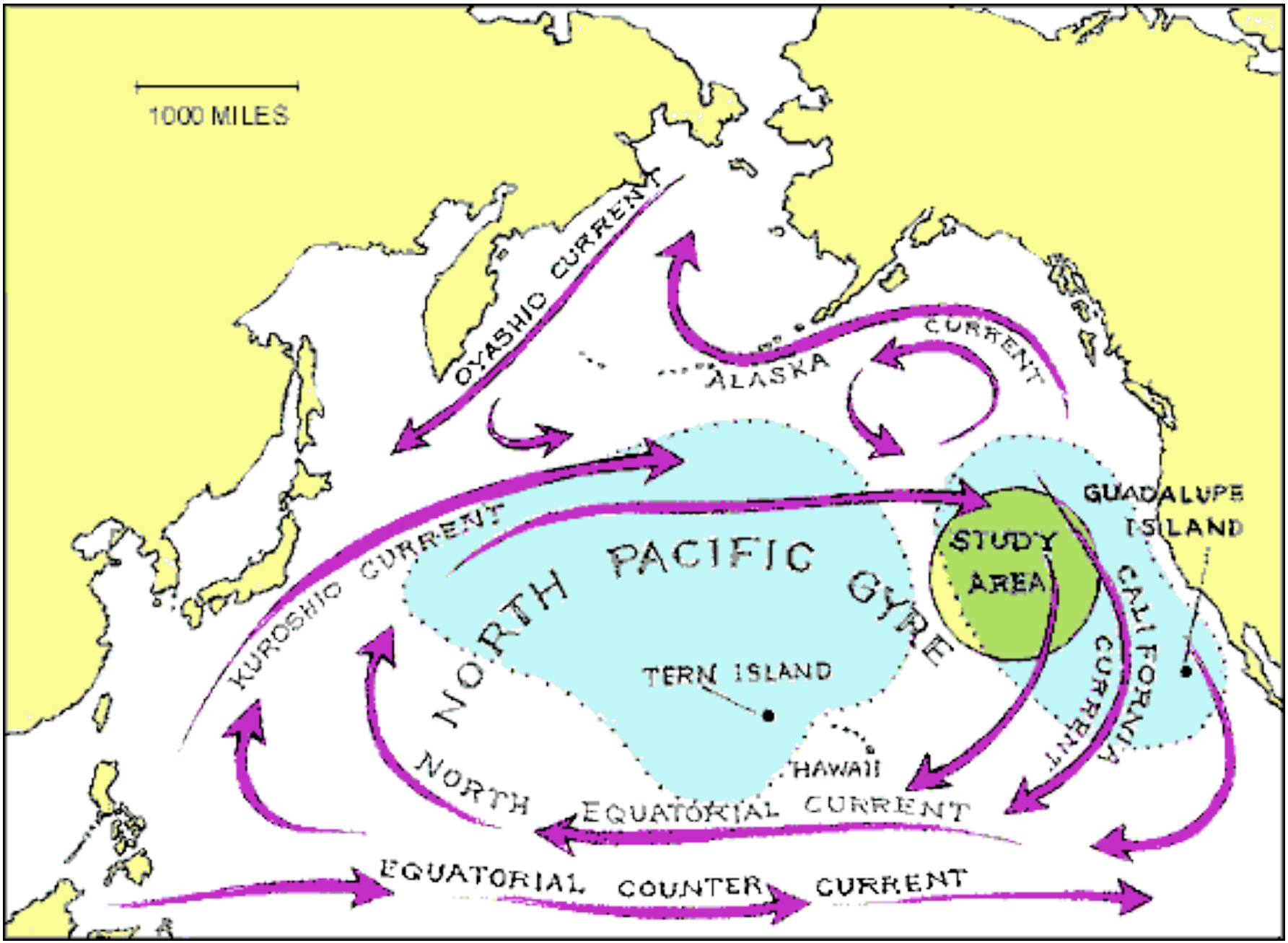
(Use the space below to create a plastic dichotomous key)

Suggested Categories: **size, weight** (buoyancy in salt water), visibility (transparent/translucent) and **color** (attractive/not attractive to birds)

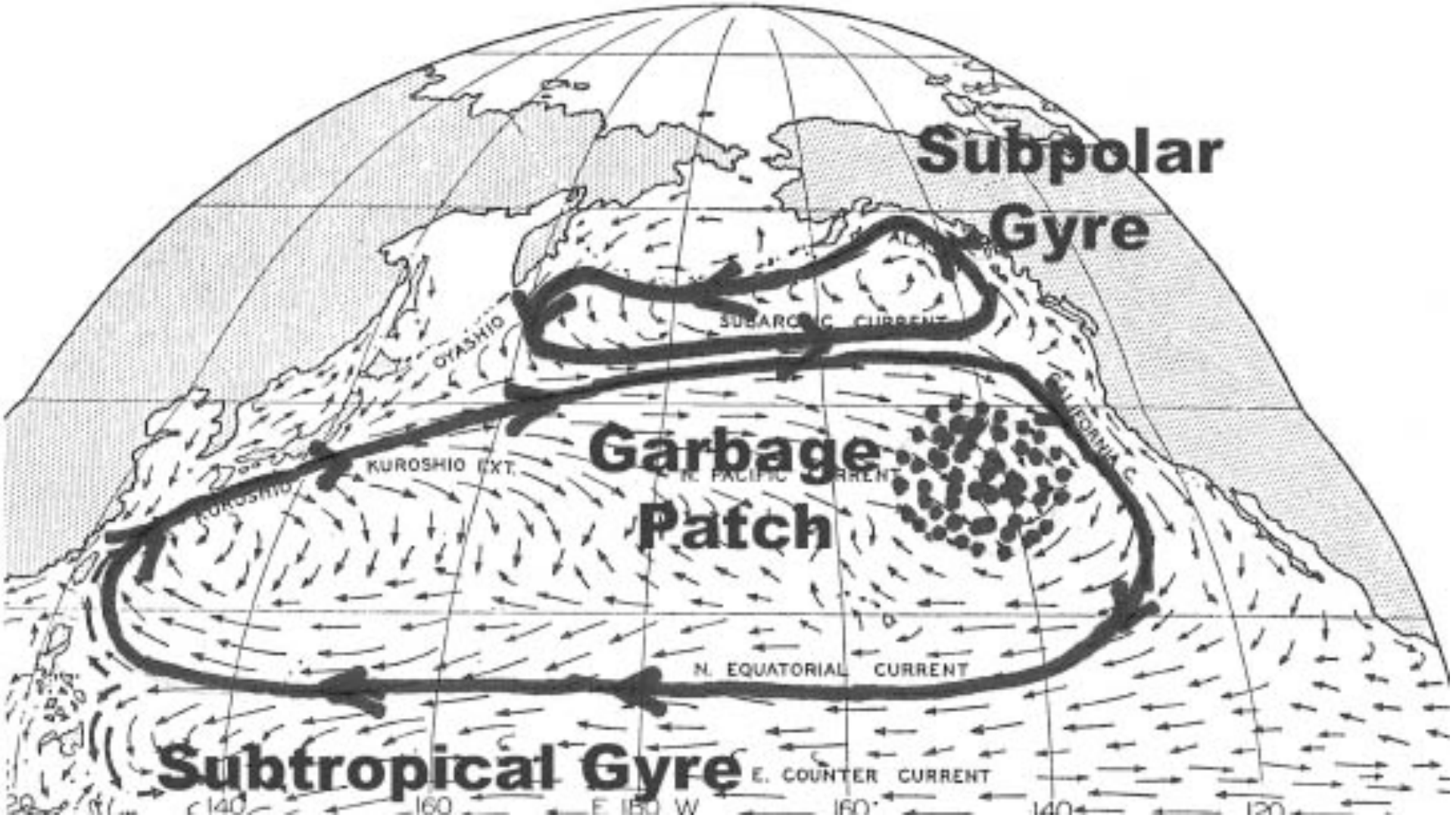
Map #4: Plastic zone data courtesy of Algalita Marine Research Foundation (AMRF). See www.algalita.org



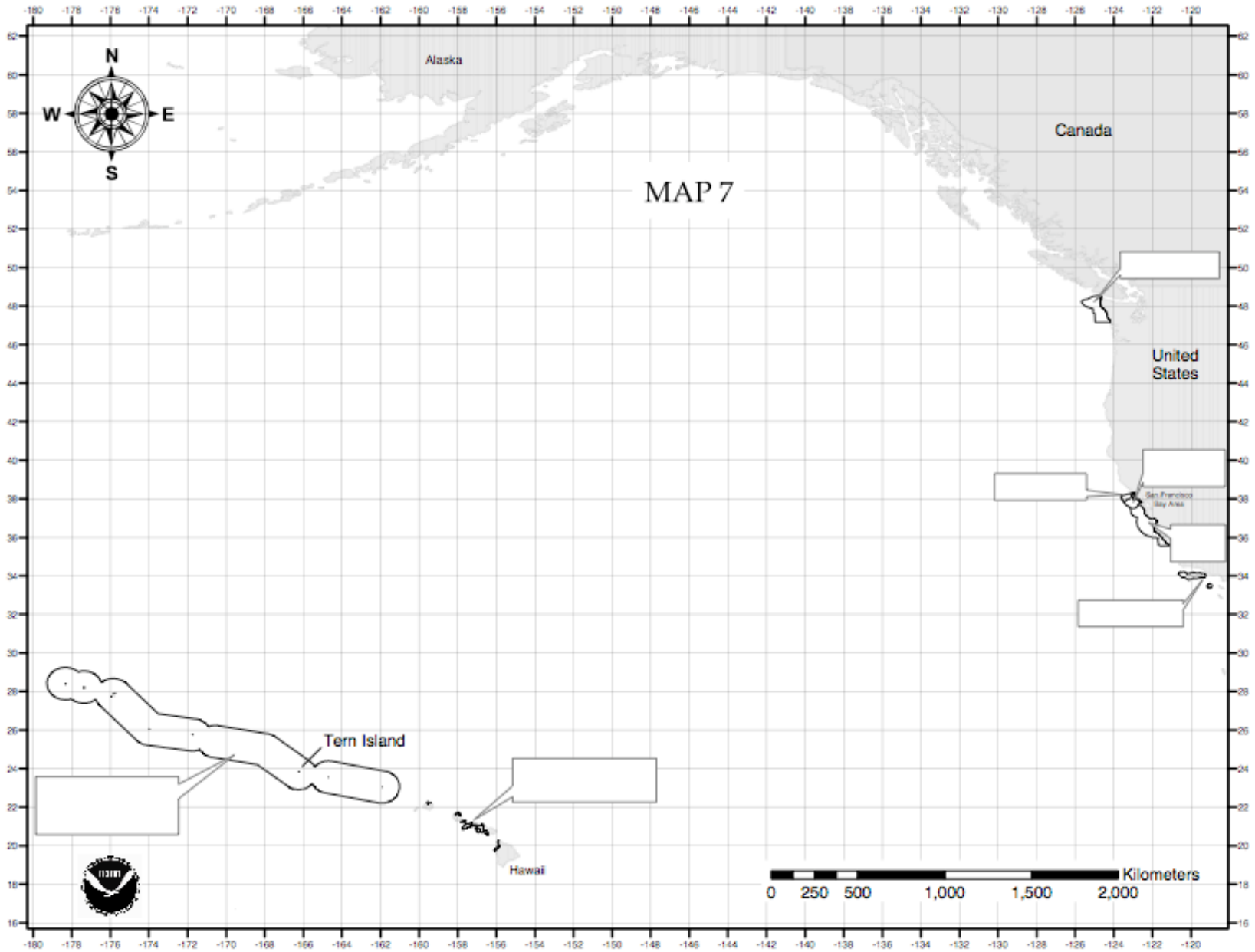
Map #5: Courtesy of Algalita Marine Research Foundation



Map #6 Source Jim Ingraham (www.beachcombers.org/)



Map #7 National Marine Sanctuaries in the North Pacific Ocean



STUDENT QUESTION SHEET: BLACK-FOOTED ALBATROSS DIET QUESTIONS

1) Summarize what you have learned about satellite tracking studies.

2) Why do scientists want to know where black-footed albatross travel during the non-breeding season?

3) Where did the tagged black-footed albatrosses travel during the 2004 tracking study? What national marine sanctuaries did they spend most of their time in?

4) Why do scientists want to know about the diet of black-footed albatrosses?

5) Summarize what you have learned about the contents of an Albatross bolus. What proportion of the bolus contained evidence of prey e.g. squid beaks? What proportion of the bolus contained plastic items? Other items?

6) What were some of the patterns of the plastic you observed e.g. size, specific shape, colors, sources?

7) After examining the bolus, did you determine if there was any evidence of selective feeding e.g. did you find that only a particular kind of plastic had been ingested?

8) How would the wind direction and strength affect the location and availability of plastic to seabirds?

9) What are some other threats to Albatrosses?

10) List at least 5 things that you can do to help conserve Albatrosses and other marine life that are affected by plastic marine debris.

11) List 3 ways plastic can harm seabirds

12) What other wildlife is also affected by plastic? How are these animals affected?

13) How is plastic harmful to humans?

14) Are there alternative to using plastic? Which ones can we as consumers use or reduce our use of in our daily lives?

15) How does plastic get into the oceans?

16) What are the laws in prohibiting the dumping of plastic into ocean?

17) How do National Marine Sanctuaries protect marine life and marine habitats?

TEACHER ANSWER GUIDE/BLACK FOOTED ALBATROSS DIET QUESTIONS

1) Summarize what you have learned about satellite tracking studies.

Satellite tracking studies allow us to see where albatross migrate, what types of ocean habitats they use and locations of overlap of potential threats e.g. large plastic accumulation zones, interactions with longline fishing

2) Why do scientists want to know where BFAL travel during the nonbreeding season?

Most studies have been conducted at the breeding colony sites and not much is known about where they travel during the nonbreeding season. This is important information because they were recently listed as endangered and knowing where they go and feed while at sea is a critical first step for their conservation.

3) Where did the BFAL travel during the 2004 tracking study?

The tagged birds traveled south and west. The Black-footed Albatross spent some time in the 3 central California coast national marine sanctuaries and then ventured outside the US Economic Exclusive Zone (EEZ) which is the 200 nautical mile ocean region adjacent to the coast where the US can manage and enforce fishing activities in what is known as the "high seas". Three birds ranged into the western north Pacific Ocean, west of the International Dateline 180 W and approximately 50% of the locations within the US EEZ occurred within the 3 national marine sanctuaries.

4) Why do scientists want to know about the diet of BFAL?

Scientists want to know about the diet of the BFAL because this will be another method to understand where they go to feed. Some species of fish and squid are found only in certain locations so knowing about their diet is another piece of the puzzle about how and where they spend their lives at sea.

5) Summarize what you have learned about the contents of an Albatross bolus. What proportion of the bolus contained evidence of prey e.g. squid beaks? What proportion of the bolus contained plastic items? Other items?

Mostly plastic items in the bolus, have students work out percentages

6) What were some of the patterns of the plastic you observed e.g. size, specific shape, colors, sources?

7) After examining the bolus, did you determine if there was any evidence of selective feeding e.g. did you find that only a particular kind of plastic had been ingested?

8) How would the wind direction and strength affect the location and availability of plastic to seabirds?

Winds that blow along the surface of the water cause the water to flow in roughly the same direction as the wind, thus plastics are affected by the wind and currents and get transported throughout the oceans. Strong winds would tend to disperse and scatter plastic however, when combined with currents, plastic could become very concentrated in certain locations. Plastic pieces floating partly above the surface are pushed more by the wind and move faster than submerged pieces.

9) What are some other threats to Albatrosses?

One of the major threats to Albatrosses is longline fishing. A characteristic behavior of albatrosses around the planet is to follow fishing boats to feed on offal (fish scraps and guts) Unfortunately, they also eat bait on hooks set by longline fishing vessels and these encounters result in injury or death by drowning. Other threats to their survival are oil spills, entanglement in gill nets, and introduced species e.g. rats, cats, dogs, and goats on remote islands where they breed.

10) List at least 5 things that you can do to help conserve Albatrosses and other marine life that are affected by plastic marine debris.

1. Participate in coastal cleanup events along ocean beaches and along rivers, streams, and creeks. Rivers flow into the sea and any plastic litter along beaches inland can be transported to the sea
2. Reduce your use of plastic (e.g. use canvas bags for shopping) especially single use throw away plastics
3. Reuse plastic bags
4. Recycle plastic bags
5. Find out what local government is doing to reduce practice, get involved

11) List 3 ways plastic can harm seabirds. What other wildlife is also affected by plastic?

1. damage to stomach lining and gut 2. seabirds become too full of plastic to eat any food
3. release of toxic chemicals into the bird Marine mammals, Sea turtles, Fish, Plankton such as

jellyfish and salps are affected by marine debris.

12) How are these animals affected? *Plastic ingestion and entanglement*

13) Are there alternative to using plastic? Which ones can we as consumers use and what are ways we can reduce the use of plastic in our daily lives?

There are many alternatives to plastic and many products now are being developed that use recycled plastic to make a new "plastic like" material. We as consumers can have a huge impact on this planet. We can reuse many materials, reduce or avoid use of disposable products and packagiing, buy food in bulk. Use glass and stainless steel whenever possible. Use reusable shopping bags etc.

14) How does plastic get into the oceans?

Littering by beachgoers, blown from upland sources, runoff from land-based activities, overboard disposal from boating activities (including accidental spills)

15) How is plastic harmful to humans?

1. Overwhelming evidence exists that indicates plastic pollution is a threat to marine biodiversity during a time when there are already great risks from over-fishing, and climate change
2. Because Persistent Organic Pollutants (POPs) may be one of the major impacts on wildlife and humans; these chemicals are everywhere, in our homes, workplaces, and where our children learn and play. Many POPs are used in plastics and plastics absorb POPs from marine environments
3. There is a great need for research on microlevel changes caused by persistent chemicals in animal bodies; it has been found that POPs may alter immune systems, induce abnormal thyroid function, decrease fertility rates and also may cause disruptions in the sex characteristics thus altering the sex ratios of populations

16) What are the laws in prohibiting the dumping of plastic into ocean?

The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years. The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted on 2 November 1973 at IMO and covered pollution by

oil, chemicals, harmful substances in packaged form, sewage and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety and Pollution Prevention in February 1978 held in response to a spate of tanker accidents in 1976-1977. (Measures relating to tanker design and operation were also incorporated into a Protocol of 1978 relating to the 1974 Convention on the Safety of Life at Sea, 1974).
As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), and it entered into force on 2 October 1983 (Annexes I and II).
The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes.
Annex V deals with Prevention of pollution by garbage from ships and was adopted in 1988. Annex V deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The requirements are much stricter in a number of "special areas" but perhaps the most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic.

18) How do National Marine Sanctuaries protect marine life and marine habitats?

The National Marine Sanctuary program is a program under NOAA (National Oceanic and Atmospheric Administration) that seeks to promote conservation while allowing for compatible uses such as recreation, fishing, shipping, etc. As of 2006, there are 13 national marine sanctuaries in the system and one Marine National Monument in the Northwest Hawaiian Islands. Each sanctuary was designated at a different time to protect extraordinary biological or cultural resources. Regulations vary from site to site based on the management issues associated with the area. Each sanctuary seeks to protect their marine (and in some cases fresh water) resources through education, research, monitoring, regulation, and enforcement.